

# **Environment, Health and Safety Division Integrated Functional Appraisal of the Materials Sciences Division**

**FY 2000**

**Final Report  
25 September, 2000**

## **1.0 Executive Summary**

The Environment, Health and Safety Division (EH&S) conducted an Integrated Functional Appraisal of the Material Sciences Division (MSD) during August and September, 2000. The Appraisal consisted of initial scope discussions, records review, and inspection of spaces to identify uncontrolled hazards. The inspection team was comprised of technical specialists from EH&S, Department of Energy Berkeley Site Office observer, and the MSD Division Safety Coordinator.

The results of the Appraisal are:

- Material Sciences has a large and diverse research spectrum, with activities spread out over four building complexes at LBNL and more at UC Berkeley. In recognition of this diversity and the importance of safety in its operations, the Division has provided senior level support of its safety program with the appointment of Joel Ager to the position of Safety Coordinator.
- Training compliance (Job Hazard Questionnaire and class completion) is generally good. The Division has instituted several innovative programs to assure that its training responsibilities are discharged.
- Waste compliance has been a continuing issue, with problems with identification of wastes and accumulation beyond permissible intervals. The Division has instituted new policies intended to solve these problems, policies that were implemented during Summer 2000.
- Chemical safety and industrial hygiene issues are generally well addressed. Minor chemical storage problems were noted. There were several locations where hydrofluoric acid was being used without a current emergency first aid kit, which can be easily upgraded.
- There were several systems that required pressure relief devices that were not present, part of which can be traced to previous interpretations of this requirement that cannot presently be supported. This is a Laboratory-wide issue, and EH&S is preparing guidance on complying with this requirement.
- There were multiple inspection findings relating to deficiencies in electrical safety and workstation ergonomics. These areas should be emphasized as the Division's safety program moves forward.

Overall, safety within the Material Sciences Division has excellent management support, and the Division has a safety program that is innovative and effective at identifying and controlling hazards. With a solid program and training foundation in place, vigilance needs to be continued in the areas of hazardous waste management, electrical safety, and workstation ergonomics.

## **2.0 Introduction**

The Integrated Functional Appraisal (IFA) is a key component of Lawrence Berkeley National Laboratory's Integrated Safety Management (ISM) system. It is part of Core Function #5 (Continuous Improvement) of the ISM concept, and forms one of the three tiers of the Laboratory's safety assessment program that evaluates the ongoing effectiveness of Divisions' Integrated Safety Management programs. LBNL's Environment, Health and Safety (ESH) Division has been conducting IFA's of all laboratory organizations since 1996, with each organization reviewed every three years. The Material Sciences Division's last IFA was conducted during 1997.

## **3.0 Appraisal Process**

### **3.1. Determination of Scope, Preparation for Site Visits**

The IFA Team Leader (John Seabury) met with Russell Ellis, the Material Science Division's Safety Coordinator, in early 2000. They reviewed the past Division Self-Assessment reports; Management of Environment, Health and Safety (MESH) report; previous IFA report; SAA Compliance Inspection reports; and the existing Integrated Hazards Assessment (IHA) database entries, developed initially in 1996 and updated during the 1997 IFA process. This current review was undertaken to ascertain whether there were problem areas, gross inaccuracies (e.g., researchers had moved, division no longer occupied that space, etc.), or changes. It was determined that the research activities as reflected in the existing recorded information had not changed significantly in the period between the two appraisals although many operations had changed locations. From this discussion emerged a list of operations to be reviewed during the site visits and the principal hazards that might be present.

To assure that the proper spaces were visited, the IFA Team Leader determined the spaces that the Material Sciences Division presently occupied (by downloading this information from LBNL's Space Database), and compared that list with the list of spaces occupied during the 1997 IFA. He then updated the information based upon the current MSD "space map" of what research program occupies what spaces, and developed a list of spaces to visit. The list of spaces was based upon:

- Research activities listed as having "Medium" or "High" level of concern hazards;
- New research activities initiated subsequent to the 1997 IFA and not included in the existing IFA database; and
- A selection of approximately 25% of operational (non-office) spaces having "Low" or "No" level of concern hazards.

Spaces assigned to MSD but located on the UC Berkeley Campus were not included in the appraisal. (MSD does not maintain any spaces in Donner or Calvin, for which LBNL is responsible; all other UCB spaces are the responsibility of UCB Environment, Health and Safety per Memorandum of Understanding).

Spaces chosen for visit are listed in Appendix A. A total of 130 spaces were visited.

### **3.2. Compliance Records Review**

Prior to the site visits, records of Job Hazard Questionnaire completion, required training completion, and waste compliance were reviewed (note: these items are also included in the Division's annual Self-Assessment).

### 3.3 Appraisal Team

The appraisal team members, and the hazard areas for which each was responsible, were:<sup>1</sup>

John Seabury (EH&S) - Appraisal Team Leader, industrial hygiene and pressure safety

Ken Barat (EH&S) - laser safety, electrical safety

Matt Kotowski (EH&S) - general safety and accident prevention

Larry McLouth (EH&S) - industrial hygiene and laboratory safety

Peter Ruegg (MSD) - representing the Material Sciences Division Safety Coordinator<sup>2</sup>

Donna Spencer (DOE) - DOE Berkeley Site Office Representative - Observer

Members of the Material Sciences Division staff that participated in the Appraisal included Joel Ager, Doreen Ah Tye, Eric Anderson, Jeffrey Beeman, René Delano, Saskia Hopper, John Jacobsen, Keith McCrae, Aric Opdahl, Doug Owen, Fabien Pinaud, Andreas Schumacher, Hughes Silvestri, and James Wu.

### 3.4 Site Visits

The inspection team visited the sites during August and September 2000. Each site visit began with an opening conversation with the individual responsible for that space (if he/she was present) and an explanation of the purpose of the visit. During the visits the team made reference to the standard inspection checklists developed for the IFA process. Recording was done on the "Hazards, Equipment, and Authorizations Review" data entry sheet that is presently (mid-2000) being implemented. These data entry sheets were turned over to HEAR implementation staff for data input.

Findings from each space were discussed with the person responsible for that space (if present) at the time of the inspection.

## 4.0 Results

### 4.1 Compliance Records Review

*Training:* MSD has been aggressive in pursuing its training responsibilities. This division is large and has a diverse spectrum of research activities, and as such it not always convenient for individuals to attend training during normal business hours. MSD has developed training alternatives, with many standard training modules available in multiple formats such as CD-ROM, and web-based streaming video. They also have created Division-specific Job Hazards Questionnaire and Orientation modules to enable more specific training identification.

During the records review it was found that training records did not reflect that many MSD employees are assigned full-time to the UC Berkeley campus, and are not required to attend the LBNL class indicated by their Job Hazards Questionnaire. The training records were corrected to provide "waivers" for UC Berkeley employees.<sup>3</sup>

As of late September, 2000 the training database shows MSD with an 85% Job Hazards Questionnaire completion rate. Out of the 67 individuals who have not completed the JHQ, 47 are listed as "guest" status at LBNL. It is likely that most if not all of these 47 are either short-term guests or newly arrived students. Backing these 47 out of the calculation, the adjusted JHQ completion rate is 95%, an excellent effort that is among the most aggressive at LBNL.<sup>4</sup>

Also as of late September, 2000 the training database shows that 89% of the classes identified as "required" by the Job Hazards Questionnaire had been completed. In general, employees are required to complete all

identified classes within six months of their hire date. When classes are backed out for those individuals with hire date within the last six months, the completion rate increases to 91%. There are, however, several long-term employees who show training deficiencies, which should be addressed.

Over the past several months EH&S has been making significant changes to the training database. There formerly was some question as to the reliability of the numbers derived due to missing or incomplete data. MSD should scrutinize the data to be sure it accurately reflects conditions.

*Hazardous Waste Management:* Hazardous waste compliance has been problematic. The EH&S Waste Management unit inspects MSD's hazardous waste Satellite Accumulation Areas and Waste Accumulation Area on a quarterly basis. MSD has had continued problems with compliance, with issues generally relating to identification of wastes and accumulation of wastes beyond the acceptable dates. In one instance, polychlorinated biphenyls (PCB) were found in waste oil, and the PCB contaminated a larger shipment that resulted in significant costs for the Division and for EH&S. In another instance, wastes were found in several Satellite Accumulation Areas that had not been disposed of over a year after they were generated in violation of state and federal regulations. The above resulted in MSD receiving multiple Nonconformance and Corrective Action Reports (NCAR's) over the past few years.

MSD has become aggressive in its correction of these problems. Policy and practice changes that have been made include:

- The oil accumulation drum now is now keyed. Anyone wishing to dispose of oil into the drum must specifically clear this through the custodian, Peter Ruegg. This controls access and will reduce the opportunity for inadvertently disposing of PCB's.
- A clearly visible sign indicating the disposal due date has been issued for all Satellite Accumulation Areas.
- The Division now has a policy that wastes must be disposed of within six months. This will allow "flagging" of due wastes prior to their being illegal.
- The Division now fines research groups who do not comply with appropriate regulations. While admittedly after-the-fact, this is intended to raise consciousness and provide consequences for individual group's actions.

## **4.2 Site Visits**

Findings and actions resulting from the site visits are presented in Appendices B-E. Appendix F contains resource information for some of the corrective actions. In general, given the varied and intense nature of the Division's research, spaces were well maintained, indicating effectiveness of the Division's Self-Assessment inspections. There were a total of 173 findings, of which 11 are high priority for correction (indicated in yellow).

Findings where consistent issues were noted include:

*Chemical Safety and Industrial Hygiene:* MSD has generally good compliance with safe use of chemicals. There were a few minor chemical storage issues noted (incompatible chemicals, storage outside of appropriate storage areas, secondary containment needed). There were more consistent findings dealing with hydrofluoric acid (HF), which is widely used within the Division. Many of the HF emergency first aid kits had been superceded but not replaced, and in some cases the spill response kits for HF were not appropriate for that acid (see Appendix F for first aid and spill kits).

*Pressure Safety:* MSD uses compressed gas from cylinders for a wide variety of uses. For the most part, compressed gas safety is widely recognized and dealt with. There were several findings of lack of required pressure relief devices on compressed gas systems; this could be traced to a previous interpretation of the requirement for pressure relief devices that cannot presently be supported. The issue of pressure relief devices on compressed gas cylinder systems is a Laboratory-wide issue, and EH&S is developing guidance on implementation of the requirements. There were no imminent hazards noted with respect to pressure safety.

*Electrical Safety:* Several pieces of apparatus had exposed live conductors, which could lead to electric shock if accidentally contacted. Also, blocked electrical panels was a fairly consistent finding (see Appendix F for clearance requirements). Electrical safety is a high priority with the Division, who employs a half-time electrical expert to assist with safe installations. It appears, however, that consciousness needs to be raised again about this important safety issue.

*Workstation ergonomics:* Within the last five years the Division has experienced five workstation ergonomics-related injuries, and review of Division spaces indicates varied compliance with the principles of good workstation design and use. This issue needs to be given higher attention for correction.

*Seismic bracing:* Many installations were noted in which large portable cryogen dewars were not secured against seismic movement. It appears that this may be due to a previous interpretation that while in use these items did not need to be secured, an interpretation that cannot at present be supported. This issue will be clarified during the coming months. Overall, however, seismic bracing issues were well considered and compliance is excellent.

## **5.0 Conclusions**

Safety within the Material Sciences Division has excellent management support, and the Division has a safety program that is innovative and overall effective at identifying and controlling hazards. With a solid program and training foundation in place, vigilance needs to be continued in the areas of hazardous waste management, electrical safety, and workstation ergonomics.

<sup>1</sup> Material Sciences is audited quarterly for hazardous waste compliance. A waste compliance inspection was conducted in late June, 2000 and the next is scheduled for September, 2000. Because of EH&S's ongoing high level of oversight of MSD's hazardous waste programs, it would have been redundant to include a Waste Management representative on the audit team.

<sup>2</sup> Russel Ellis was the Division Safety Coordinator until his retirement in March 2000. Joel Ager, Senior Staff Scientist, assumed the Division Safety Coordinator position at that time. Peter Ruegg works closely with Joel Ager to implement the safety program.

<sup>3</sup> Although the specific LBNL course requirements do not apply to UCB-based employees, the content requirements do apply in that MSD is required to assure that all employees are properly trained. MSD has instituted a "Training Certification," completed by the supervisor, that certifies that the individual has been properly trained even if he/she has not taken specific classes that he/she would have if sited at LBNL.

<sup>4</sup> When ALL guests are backed out of the calculation (which would exclude long-term students), the JHQ completion rate is 93%—still an excellent number.

# Appendix A

## Sites Included in

### FY 2000 IFA Inspections

Building Number	Room Number	Survey Group <sup>5</sup>
002	0102	G
002	0105	B
002	0111	B
002	0113	B
002	0115	B
002	0115A	B
002	0119	B
002	0126A	G
002	0126C	G
002	0137	B
002	0207	B
002	0214	D
002	0216	D
002	0221	B
002	0222	D
002	0224	D
002	0229	B
002	0230	G
002	0237	B
002	0238	D
002	0241	B
002	0243	B
002	0245	B
002	0247A	D
002	0247B	D
002	0256	D
002	0258	B
002	0260A	D
002	0260B	D
002	0261A	D
002	0261B	D

002	0261C	D
002	0263A	D
002	0263B	D
002	0307	C
002	0321	C
002	0326	C
002	0328	C
002	0338	C
002	0340	C
002	0357	D
002	0358	B
002	0359	C
002	0360	B
002	0407A	C
002	0422	C
002	0423	C
002	0426	C
002	0428	C
002	0434	C
002	0435A	C
002	0435B	C
002	0435D	C
002	0441A	C
002	0441B	C
002	0448	C
002	0455	C
002	0458	C
062	0100	A
062	0100A	F
062	0100B	E
062	0100C	E
062	0100D	A
062	0101	F
062	0102	E
062	0104	A
062	0108	G

062	0108B	G
062	0108E	G
062	0108F	G
062	0110	E
062	0119	A
062	0127	A
062	0127A	A
062	0127B	A
062	0135	E
062	0138	E
062	0142	A
062	0149	G
062	0150	E
062	0155	G
062	0201	A
062	0208	A
062	0310	E
062	0316	E
066	0207	F
066	0210	F
066	0219	E
066	0221	E
066	0224	F
066	0225	A
066	0229	F
066	0231	F
066	0232	F
066	0301	E
066	0304	E
066	0306	E
066	0310	F
066	0313	F
066	0314	F
066	0322	E
066	0324	E
066	0328	F



066	0331	F
066	0334	F
066	0335	F
066	0401	A
066	0403	A
066	0407	A
066	0409	E
066	0411	A
066	0416	A
066	0421	A
066	0424	A
066	0426	A
066	0427	A
066	0430	A
066	0433	A
072	0101	E
072	0102	G
072	0107A	E
072A	0010	E
072A	0210	E
072B	0010	F
072B	0110	F
072B	0210	F
072C	0163	F
072C	0167	F
072C	0167A	F
072C	0212	G
<sup>5</sup> The surveys were undertaken in groups of approximately 25 spaces per survey, with the individual spaces chosen for groups based upon their physical proximity and similarity of hazards. There were seven surveys, each taking approximately one half day..		

## Appendix B

### Findings: Material Sciences Division Integrated Functional Appraisal 2000 Building 2

Building	Room	Finding	Action
2	102	Electrical subpanels were blocked by stored materials.	MSD to maintain clear access to electrical panels.
		Multiple large cryogen dewars were not restrained against movement.	MSD to install and use restraints
		A freestanding argon system did not have pressure relief.	MSD to determine the Maximum Allowable Working Pressure and install a pressure relief device near the regulator.
		The gas mixing manifold in the fume hood did not have check valves installed to prevent fuel flow in the incorrect direction.	MSD to provide and install check valves.
		The hydrofluoric acid burn kit is out of date (superceded) and should be replaced.	MSD to contact Health Services to obtain currently dispensed burn kit.
		The acid spill kit in the laboratory may not be suitable for spills of hydrofluoric acid.	MSD to confirm suitability of this kit and replace if necessary.
	113	The supplemental cooling fan assembly mounted in the ceiling is powered with an extension cord.	MSD to substitute fixed wiring for the extension cord, or contact Facilities and get supplemental cooling for the area.
	126A	An electrical subpanel was blocked by a large trashcan.	MSD to maintain clear access to electrical panels.
		Two metal bandsaws had the portion of the blade located underneath the table exposed to accidental contact.	MSD to provide and install guards.
	137	The large liquid argon dewar was not restrained against movement.	MSD to install and use restraints.
		An electrical subpanel near the double exit doors was blocked by stored materials.	MSD to maintain clear access to electrical panels.
	207	A vacuum pump is leaking a considerable amount of oil into the containment pan.	MSD to dispose of the oil and look into rebuilding the pump.
		Liquid cryogen dewars were not secured against movement.	MSD to install and use restraints.
		There is no overpressure relief device installed on the gas helium system.	MSD to determine the Maximum Allowable Working Pressure and install a pressure relief device near the regulator.
	214	There is no overpressure relief device installed on the gas helium system.	MSD to determine the Maximum Allowable Working Pressure and

			install a pressure relief device near the regulator.
		The helium system valves are not securely mounted and impart strain to the connecting piping.	MSD to securely mount valves.
		The low bookshelf needs to be restrained against movement.	MSD to install and use restraints
	216	The hydrofluoric acid burn kit is out of date (superseded) and should be replaced.	MSD to contact Health Services to obtain currently dispensed burn kit.
		The acid spill kit in the laboratory may not be suitable for spills of hydrofluoric acid.	MSD to confirm suitability of this kit and replace if necessary.
		There is a mercury thermometer in the room that should be replaced with an alcohol thermometer to avoid a possible future mercury spill.	<i>Recommendation:</i> MSD to inventory all mercury thermometers, EH&S will provide alcohol thermometers through the thermometer exchange program.
	221	A block and tackle system used to raise a system component has been installed on the Unistrut frame over the system. This installation does not appear to have been properly made.	MSD to contact Facilities to determine if 1) the hoist has been properly installed; and 2) the Unistrut frame can withstand the rated loads.
		An electrical subpanel at the middle of the room was blocked by stored materials.	MSD to maintain clear access to electrical panels.
	222	The mini-drill press does not have a guard around the drive belt to preclude contact.	MSD to install a guard.
	224	The hydrofluoric acid burn kit is out of date (superseded) and should be replaced.	MSD to contact Health Services to obtain currently dispensed burn kit.
		The acid spill kit in the laboratory may not be suitable for spills of hydrofluoric acid.	MSD to confirm suitability of this kit and replace if necessary.
	229	Electrical components associated with the magnet were not restrained against movement.	MSD to install and use restraints.
	237	There is no overpressure relief device installed on the gas helium system.	MSD to determine the Maximum Allowable Working Pressure and install a pressure relief device near the regulator.
		The fitting on the end of the gas helium delivery hose appears to have a small hole, posing a potential helium injection hazard to personnel if it contacts skin.	MSD to determine what the device is and whether it is necessary. If it must be installed on the hose than a guard of some sort should be installed to protect against accidental injection.

	247A	There is a cylinder of deuterium that was last pressure tested in 1949. This indicates that the use of this material is minimal.	MSD to evaluate whether this cylinder needs to be retained on site.
		There is no overpressure relief device installed on the oxygen distribution system.	MSD to determine the Maximum Allowable Working Pressure and install a pressure relief device near the regulator.
	247B	The hydrofluoric acid burn kit is out of date (superceded) and should be replaced.	MSD to contact Health Services to obtain currently dispensed burn kit.
		The local exhaust hood over the glass blowing station is not connected to the exhaust ventilation system.	MSD to determine if the glassblowing area is used. If so, the hood needs to be reconnected so that installed engineered control devices perform as designed.
	256	The acid spill kit in the laboratory may not be suitable for spills of hydrofluoric acid.	MSD to confirm suitability of this kit and replace if necessary.
	258	The table on which the old sputter coater is installed is not secured against movement.	MSD to secure the table to the wall or other structural element.
		There is no overpressure relief device installed on the gas argon system.	MSD to determine the Maximum Allowable Working Pressure and install a pressure relief device near the regulator.
	260A	The hydrofluoric acid burn kit is out of date (superceded) and should be replaced.	MSD to contact Health Services to obtain currently dispensed burn kit.
		The acid spill kit in the laboratory may not be suitable for spills of hydrofluoric acid.	MSD to confirm suitability of this kit and replace if necessary.
		There is no overpressure relief device installed on the gas distribution system.	MSD to determine the Maximum Allowable Working Pressure and install a pressure relief device near the regulator.
	261A	The hydrofluoric acid burn kit is out of date (superceded) and should be replaced.	MSD to contact Health Services to obtain currently dispensed burn kit.
		The large liquid helium dewar was not restrained against movement.	MSD to install and use restraints.
		The large treatment system liquid bucket was not restrained against movement.	MSD to install and use restraints.
	261C	The mini-drill press does not have a guard around the drive belt to preclude contact.	MSD to install a guard.

	263A	The hydrofluoric acid burn kit is out of date (superceded) and should be replaced.	MSD to contact Health Services to obtain currently dispensed burn kit.
		The acid spill kit in the laboratory may not be suitable for spills of hydrofluoric acid.	MSD to confirm suitability of this kit and replace if necessary.
	263B	The hydrofluoric acid burn kit is out of date (superceded) and should be replaced.	MSD to contact Health Services to obtain currently dispensed burn kit.
	307	There is a chemical storage refrigerator that needs to be labeled "No Food Storage" or equivalent	MSD to label the refrigerator.
		A cylinder of 4% hydrogen in nitrogen is sitting unused, but has a regulator installed.	MSD to remove the regulator and cap the cylinder.
	321	There are vacuum pumps associated with the glovebox and other equipment that do not have secondary containment under them to catch oil leaks.	MSD to supply secondary containment.
	326	There is a bookcase-type shelf unit over the main workbench that is not secured against falling.	MSD to install adequate restraints to prevent falling during an earthquake or other event.
		There is a large parts bin on the top shelf of the bookcase-type shelf unit that is not secured against tipover in the event of an earthquake.	
	328	The black vacuum pump does not have secondary containment under it to catch oil leaks.	MSD to supply secondary containment
	338	There is a small drybox in the lab containing many reactive chemicals. This drybox does not belong to the research group using the lab, and gets in the way.	MSD to investigate having the actual owner of the drybox move it and its contents to the owner's laboratory.
	340	Hydrofluoric acid is used in this laboratory, but an HF burn kit is not present.	MSD to contact Health Services to obtain currently dispensed burn kit.
		Hydrogen is piped through rubber tubing. Flammable gases must be in steel tubing.	MSD to install the proper tubing to replace the rubber tubing.
		There is a Class D fire extinguisher present, but no obvious need for a Class D extinguisher.	MSD to verify what the need is for the Class D extinguisher. If it is not needed then it should be recycled or disposed of so that it is not inadvertently grabbed to put out a conventional fire.
	357	Several razor blades, apparently used	MSD to assure that all sharps are

		and discarded, were lying around.	disposed of in sharps containers.
		Several items in the lab require restraint against movement - chiller, refrigerator, power supply, computer racks	MSD to install adequate restraints to prevent moving/falling during an earthquake or other event.
	358	Liquid cryogen dewars were not secured against movement.	MSD to install and use restraints.
	360	There is no overpressure relief device installed on the gas helium system.	MSD to determine the Maximum Allowable Working Pressure and install a pressure relief device near the regulator.
		Combustible materials (rags) were stored in the electrical cable trays.	MSD to remove the combustible materials.
		Liquid cryogen dewars were not secured against movement.	MSD to install and use restraints.
		There were a number of bolts, cords, nuts, and other components on the floor, posing slipping hazards.	MSD to maintain the floors clean and free of slip/trip fall hazards.
	407A	There are two cylinders on transport carts that have regulators installed and are apparently in use.	MSD to either properly restrain the cylinders in use against movement or else remove the regulators and cap the cylinders.
	422	An electrical panel does not have free space to allow emergency access.	MSD to remove the items that are blocking access/egress.
		Aisleways are blocked with materials.	
		The required second exit from the lab (at the end of the lab near the fume hood) is blocked by a file cabinet.	
	423	There is a power cord protruding from the back of the light green equipment rack across a sharp metal edge.	MSD to either install a proper plastic ring in the opening or otherwise secure the wire against abrasion.
		The SEV-2DC (voltage controller?) under the xray source is missing an access panel.	MSD to replace the access panel.
		Flammable materials (acetone, other solvents) and combustible materials (boxes) are stored under desks.	MSD to remove all flammables/combustibles and store flammables in a flammable storage cabinet.
	426	The computer/CAD? workstation in this room is very poorly designed, resulting in potentially damaging stress to the user.	MSD to request evaluation and recommendations for improving the workstation.
		There is a file cabinet that needs to be secured into the wall.	MSD to secure.

		The electrical panel is blocked.	MSD to provide access to the electrical panel.
	428	One of the plastic exhaust lines hooked to the house exhaust vacuum is installed in a crimped condition.	MSD to correct by providing a 90 degree elbow or other means.
	435A	Equipment racks need to be secured against movement.	MSD to secure.
		Aisleways are blocked by stored materials.	MSD to increase aisle width to a minimum of 24".
	441B	Housekeeping should be improved to increase general safety.	MSD to increase housekeeping.
	448	Several low bookcases are not secured to the wall or floor to guard against tipping. This was noted in December of 1999 as a finding #3672.	MSD to secure.
		The electrical panel is blocked.	MSD to remove blockage.
	455	Equipment rack in the NW corner of the room needs to be secured against travelling during an earthquake.	MSD to secure.
		Work area in the NW corner has boxes and other stuff stored under the desk, leading to poor ergonomic positions as well as no space for an employee to go during the earthquake.	MSD to remove stored materials.
		Ergonomic workstation conditions need to be improved for the entire room of 13 CADD stations.	MSD to improve; contact EH&S for assistance.
	458	There is an electrical panel that does not have proper clearance in front of it.	MSD to provide access to the electrical panel.

## Appendix C

### Findings: Material Sciences Division

### Integrated Functional Appraisal 2000

### Building 62<sup>4</sup>

Building	Room	Finding	Action
62	100	Lava 300 kip rolling mill: guard must be installed and properly adjusted prior to next operation.	MSD will install guard prior to operation.
		File cabinet has "Cancer Hazard" label on locked file cabinet: unknown to what that refers.	MSD to identify if the label is needed. If so, write the identity of the cancer-causing agent on the symbol. If not, remove.

100B	The smaller refrigerator has what appear to be flammables stored inside. This refrigerator is not rated for storage of flammable materials.	MSD to remove flammables from the refrigerator.
100D	This storage area is very cluttered. It needs to be cleaned up and proper aiseways established.	MSD to execute.
102	Lithium is in use in the dry box, but it appears that the only extinguishing agent available is "Metal-X", which may not be appropriate for lithium.	MSD to confirm that the proper extinguishing agent ("Lith-X") is available in cooperation with LBNL Fire Prevention.
110	Acetic acid is stored in the acid cabinet with oxidizing acids. The proper storage location for organic acids such as acetic acid is with flammables or alkalis.	MSD to separate these incompatibles.
127A	The cover had been removed from a piece of electrical apparatus mounted on a cart, exposing live 120VAC contacts.	MSD to replace cover.
135	Electrical panels are blocked.	MSD to provide access to the electrical panels.
	The pressure relief valve on the oxygen system is pointing directly into the user's face.	MSD to turn the pressure relief valve approximately 180 degrees so it points away from the user.
138	The flammable materials storage cabinet does not have a spring on the door to make the door "self-closing".	MSD to install a return spring.
142	Electrical panels are blocked.	MSD to provide access to the electrical panels.
149	There are multiple 4-legged chairs in this room and in Room 155 that are unsafe if tipped rearwards.	MSD to replace these chairs with 5-legged chairs.
150	There are alkali metals used in the dry boxes, but no extinguishing agent is readily available.	MSD to assure that proper extinguishing agents are present and obvious for immediate use.
155	There are multiple 4-legged chairs in this room and in Room 149 that are unsafe if tipped rearwards.	MSD to replace these chairs with 5-legged chairs.
	Multiple items (e.g., test rack, ovens) stored at elevated locations are not anchored against movement.	MSD to install seismic restraints.
	Large cryogen dewars need to be secured against movement.	
201	The yellow and green cutoff saw located near the glass blowing area has a chipped blade.	MSD to replace the blade before next use.
	There is a wiremaking machine that is reported to be very noisy.	MSD to request EH&S to perform a noise survey when the machine is operated.



	208	There does not appear to be any pressure relief for the nitrogen system feeding the dry box.	MSD to install.
		There does not appear to be pressure relief on other piped gas systems.	MSD to install.
		There are several items stored overhead (printers, etc.) that should be restrained by holddowns or barriers.	MSD to investigate and install restraints.
	221	Electrical panels are blocked.	MSD to provide access to the electrical panels.
		There is a quantity of flammable materials stored under the hood that should be moved to the flammables materials storage cabinet.	Flammable materials should be stored in the flammable materials storage cabinet unless in active use.
		The refrigerator should be marked "for chemicals only - no food allowed" or equivalent.	MSD to execute.
	225	There is no pressure relief for the carbon monoxide system.	MSD to determine Maximum Allowable Working Pressure for this system and install pressure relief device.
		The test chamber has several large windows that may be accidentally contacted by wrenches, other apparatus, etc. and implode.	<i>Recommendation:</i> MSD to consider installing window protection.
	310	There is a large furnace test apparatus located inside of a plywood enclosure. It is not readily apparent that the plywood is sufficient to withstand the heat produced by this furnace.	EH&S to contact LBNL Fire Protection to evaluate.
		Electrical panels are blocked.	MSD to provide access to the electrical panels.
		There is a bookcase that requires seismic anchoring.	MSD to have seismic tieback installed.
	316	There are several four-legged chairs in use in the lab, which can slip out from underneath someone and cause a fall. One of these chairs is used as a workstation chair and is not appropriate for this use.	MSD to replace with proper five legged (or more) chairs that have adjustment capability.
		The compressed gas systems in the lab need to have pressure relief devices installed.	MSD to determine Maximum Allowable Working Pressures and install the pressure relief devices where necessary.

<sup>6</sup> Yellow indicates highest Priority for correction.

**Appendix D**  
**Findings: Material Sciences Division**  
**Integrated Functional Appraisal 2000**  
**Building 66<sup>7</sup>**

<b>Building</b>	<b>Room</b>	<b>Finding</b>	<b>Action</b>
66	207	The house nitrogen line feeding several instruments does not have a pressure relief device installed to protect the equipment.	MSD to install.
		There are several gas and other distribution lines installed overhead that are not identified as to what they are.	MSD to label lines. Current American National Standards Institute requirements are to label lines every three meters (~10 feet).
	210	The electrical panel is blocked.	MSD to provide access to the electrical panel.
	219	The refrigerator that stores samples and reagents is not identified that food must not be stored inside.	MSD to label.
		There is a bottle of liquid labeled "EtBr waste" inside of the fume hood, but it does not have a hazardous waste label nor is it in a Satellite Accumulation Area. "EtBr" is ethidium bromide, which is a hazardous waste.	MSD to either put the hazardous waste in an existing SAA or establish a new SAA. The area supervisor and some of her employees have taken EHS 604 (Hazardous waste generator), but two employees have not.
	225	There is no pressure relief device installed on the carbon monoxide system.	MSD to install.
		There are no covers to protect the chamber windows against accidental damage.	<i>Recommendation:</i> MSD to investigate installing removable window covers.
	229	The free-standing clean bench needs to be seismically secured.	MSD to secure.
	231	Wires on the floor leading to the test cell form a tripping hazard.	MSD to correct.
		The safety nozzle on the gun connected to the helium cylinder on the floor has been defeated by taping a small diameter tube to the nozzle. This forms a potential gas injection hazard.	MSD to correct.
		A helium cylinder in use is lying down on the floor. It must be properly racked while in storage and use.	MSD to install rack.
	301	The refrigerator that stores chemicals is not identified that food must not be stored inside.	MSD to label.

	The flammable storage cabinets (especially the red one) emit a very strong, objectionable stench when opened. Many of the chemicals stored inside are labeled as strong stench or lacrimator.	MSD to ventilate the cabinets. Contact EH&S for guidance on the ventilation recommendations.  Also, MSD to verify that all chemicals in the cabinet are needed (dispose of those not needed through EH&S Waste Management), and that all caps are tightly screwed down.
304	It appears that there may be some flammable materials stored inside of the refrigerator, which is not rated for flammable material storage.	MSD to verify and if necessary remove the flammable materials.
	The small refrigerator that stores chemicals is not identified that food must not be stored inside.	MSD to label.
310	The 6" Workforce bench grinder has had all safety devices (face shields, tool rests, etc.) removed from it, and it has not been secured against movement.	MSD to <i>immediately</i> take this machine out of service until the safety devices are restored and it is secured to its mounting surface.
313	There are two computer monitors stored on a shelf at around 12 feet above the floor. The lips on the shelves are probably not sufficient to stop these heavy and top-heavy objects from slipping off during an earthquake.	MSD to bring the monitors down to approximately floor level for storage. Only light objects should be stored overhead.
314	There are containers of potential peroxide-forming chemicals (diethyl ether, tetrahydrofuran) stored in the flammable materials cabinet that do not have dates marked on them.	MSD to refer to guidance on peroxide forming chemicals in LBNL Chemical Hygiene and Safety Plan, and label/mark the containers accordingly.
	There are some cabinets that need to be secured against movement during an earthquake.	MSD to secure.
324	There are cans of ethers (peroxide forming chemicals) that do not have purchase and/or open dates written on them.	MSD to label with dates if the dates are available, otherwise discard and acquire new. Refer to the Chemical Hygiene and Safety Plan <a href="http://www.lbl.gov/ehs/chsp/html/reactives.htm">http://www.lbl.gov/ehs/chsp/html/reactives.htm</a> - Peroxide for guidance on peroxide forming chemicals; note that some peroxide formers are reactive in other ways as well.
	Several cabinets need to be secured to the wall against seismic movement.	MSD to secure cabinets to the wall.
328	The galvanized tray located in front of the rack of blue furnaces, and is in place to catch	MSD to mark this pan more prominently, and consider installing barriers so that this pan is not in the normal path of travel.

	spills of quench oil, is a tripping and potential slipping hazard.	
	The electrical panel is blocked.	MSD to provide access to the electrical panel.
331	Items are stored in the Waste Accumulation Area (WAA) that are not properly labeled.	MSD to either remove the materials (if they are not waste) or else label properly.
401	The cylinder gas systems require pressure relief devices.	MSD to install.
	The second exit from this laboratory is blocked by cardboard boxes.	MSD to remove the boxes and make the second exit accessible.
	A vacuum pump requires a drip pan to contain oil.	MSD to provide.
403	There is a Variac with a damaged power cord feeding a cell in the fume hood.	MSD to replace the cord and cap.
	The cell in the fume hood fed by power from a Variac, which gets its power from another Variac, has exposed electrical terminals.	MSD to cover terminals against accidental contact.
	Aisleways throughout the lab are cluttered and disorganized.	MSD to maintain aisleways at 24" minimum width without obstruction.
407	A large liquid cryogen dewar was not secured against movement during an earthquake.	MSD to secure.
	The electrical panel is blocked.	MSD to provide access to the electrical panel.
409	Two large, freestanding incubators need to be secured to the floor.	MSD to secure.
416	The electrical panel is blocked.	MSD to provide access to the electrical panel.
	The second exit from the laboratory is blocked.	MSD to remove obstructions and make exit accessible.
421	The second exit from the laboratory is blocked.	MSD to remove obstructions and make exit accessible.
424	The electrical panel is blocked.	MSD to provide access to the electrical panel.
	The second exit from the laboratory is blocked.	MSD to remove obstructions and make exit accessible.
	A large liquid cryogen dewar was not secured against movement during an earthquake.	MSD to secure.
	Oxygen and methane are	MSD to replace tubing.

		supplied to utilization points using rubber tubing, which will be consumed in a fire. Flammable and oxidizer gases must be in metal tubing.	
	426	A full nitrogen cylinder was restrained at the bottom of the cylinder only.	MSD to supply additional top chain.
		A large liquid cryogen dewar was not secured against movement during an earthquake.	MSD to secure.
		In the fume hood, used nitric acid (a strong oxidizer) was stored with flammable materials.	MSD to separate these incompatible materials.
	427	Hydrogen was plumbed to the torch in a rubber hose.	MSD to replace all portions outside of the fume hood with metallic tubing.
		The hydrogen system does not have any pressure relief.	MSD to install.
		The electrical panel is blocked.	MSD to provide access to the electrical panel.
		The second exit from the laboratory is blocked.	MSD to remove obstructions and make exit accessible.
		There were many liquid-containing, unlabelled beakers, flasks and other glassware on a benchtop.	MSD to assure that all containers are labeled.
	430	There was a spot welder with a dial indicating a capability of 1000 Volts that had exposed live terminals, including two homemade probes.	MSD to assure that machine is taken out of service until an electrical safety inspector evaluates its safety.
		The electrical panel is blocked.	MSD to provide access to the electrical panel.
		A large liquid cryogen dewar was not secured against movement during an earthquake.	MSD to secure.
	433	Storage in this room is very disorganized and many tripping hazards are present.	MSD to organize so that aisles are present and proper exiting requirements are met.
		The electrical panel is blocked.	MSD to provide access to the electrical panel.

<sup>7</sup> Yellow indicates highest Priority for correction.

## Appendix E

### Findings: Material Sciences Division

# Integrated Functional Appraisal 2000

## Building 72 Complex<sup>8</sup>

<i><b>Building</b></i>	<i><b>Room</b></i>	<i><b>Finding</b></i>	<i><b>Action</b></i>
72	102	The protective eyewear provided by NCEM needs to be replaced; existing equipment is discolored and brittle.	MSD to replace.
72A	210	The two high voltage tanks appear to be insufficiently restrained to withstand seismic events.	MSD to issue Work Request to Facilities to evaluate.
72B	10	The lights in the stairwell from the first floor to the basement apparently do not work.	MSD to issue a Work Request to Facilities for repair.
		Three turbo pumps do not have oil catch pans, and there is evidence of oil leakage on the floor.	MSD to install catch pans.
	110	The light switch at the head of the stairs that is supposed to turn on the basement lights does not work.	MSD to issue a Work Request to Facilities for repair.
	210	There are several cylinders of Freon and other gases that are not properly stored in a storage rack.	MSD to either remove the bottles or else install a storage rack.
72C	167A	There is a mercury thermometer in the room that should be replaced with an alcohol thermometer to avoid a possible future mercury spill.	<i>Recommendation:</i> MSD to inventory all mercury thermometers, EH&S will provide alcohol thermometers through the thermometer exchange program.
<sup>8</sup> Yellow indicates highest Priority for correction.			

## Appendix F

### Supplemental Information for Corrective Actions

**Electrical Panels, clearance:** Clear space in front of electrical panels must be a minimum of 30" wide, 36" deep, and the higher of 78" tall (from floor) or the top of the panel.

**Hydrofluoric Acid Burn Kits:** contact LBNL Health Services at x6266.

**Hydrofluoric Acid Spill Kits:** are available from VWR Scientific (Lab contractor, <http://www.vwrsp.com/>). NOTE: Do NOT use any spill kit containing NEUTRASORB (J. T. Baker product, packaged in kits by a number of manufacturers). NEUTRASORB does not effectively control HF spills. Choices include:

**TEAM\* "Low Na+" Liquid Neutralizer for Acid Spills.** For safe, controlled clean-up of acid spills, including hydrofluoric and perchloric acid spills. An effective acid neutralizing solution with its own pH color indicator. A low sodium liquid formulation, TEAM is easily sprayed on horizontal, vertical, and perforated surfaces. After complete neutralization, waste

materials contain neutralized alkanolamine salts of the treated acid. Includes easy-to-read instructions. The 946 ml bottle comes complete with a hand sprayer. The 19 L size consists of two 9.5 L containers which may be used with a standard 3-5 gallon, hand pressured garden-type sprayer (not included). VWR Catalogue Numbers JT4555-2 (946 ml) or JT4555-5 (19 liter).

***SPILFYTER\* KOLORSAFE\* Liquid Acid and Base Neutralizers.*** Neutralize hazardous caustics and acids, including Hydrofluoric Acid with these liquid neutralizers. Many hazardous spills involve dangerous caustics and acids. These SPILFYTER neutralization products change color as you use them to indicate when enough neutralizer has been applied to the spill. Available in 1 quart, 1 gallon and 5 gallon sizes. VWR Catalogue Numbers (for acid neutralizer) 56616-404 (quart), 56609-202 (gallon), or 56616-079 (5-gallon).

***Emergency Spill Cleanup Kits, Mallinckrodt.*** For spills involving acid, caustic, solvent or HF acid, these kits are designed to help you react quickly, effectively and efficiently. Each kit comes in a convenient, easy-to-manage carton and contains all the items needed to clean up a chemical spill up to 1 liter. Items in kits are organized in the order they will be required. Includes step-by-step instructions, goggles, gloves, converter (HF acid